ESAME DI STATO PER L'ABILITAZIONE ALLA PROFESSIONE DI INGEGNERE

SECONDA SESSIONE 2018 – SEZIONE B

SETTORE INDUSTRIALE

PROVA PRATICA DI PROGETTAZIONE

TEMA N. 6: ENERGETICA - ENERGETICA

Si consideri un impianto a vapore con ciclo di Hirn caratterizzato da una potenza termica introdotta in caldaia pari a 50 MW la quale brucia olio combustibile avente potere calorifero inferiore pari a 44 MJ/kg. Siano note le condizioni del vapore in ingresso in turbina in termini di pressione e temperatura rispettivamente di 160 bar e 550°C. Si consideri infine la temperatura dell'acqua ambiente di 18°C e la temperatura dell'aria ambiente di 20°C.

Il candidato valuti le prestazioni del sistema considerando il caso di macchina ideale e reale. Nel dettaglio si richiede:

1) Il disegno del layout del sistema energetico ed il corrispondente diagramma T-s;
2) Il calcolo degli stati fisici nei vari punti (pressione, temperatura, entalpia e titolo);
3) La valutazione delle portate e delle potenze utili;
4) Il calcolo del rendimento termodinamico dell'impianto;
5) I diagrammi di scambio termico del condensatore.

Sia il titolo allo scarico della turbina compreso tra un minimo di 0.75 ad un massimo di 0.96.

Il candidato valuti inoltre la potenza elettrica totale, l'efficienza elettrica e gli stati fisici nel caso in cui la temperatura dell'acqua ambiente sia pari a 15°C.

Tutti i parametri non esplicitamente indicati ma utili ai fini del calcolo vengano scelti in base a considerazioni di buon progetto.

Tab.1 - Proprietà termodinamiche dell'acqua alla saturazione

t	p	volume	specifico	m³/kg	Entalpia		kJ/kg	Entropia		kJ/kg K	t
°C	bar	v_l	(v_v-v_l)	v_v	h_l	r	h_v	s_l	r/T	s_v	°C
0	0.006 017	0.001 000 2	206.298	206.299	-0.0	2501.6	2501.6	-0.0	9.1578	9.1578	0
0.01	0.006 112	0.001 000 2	206.162	206.163	−0.0	2501.6	2501.6	0	9.1575	9.1575	0.01
2	0.007 055	0.001 000 1	179.922	179.923	8.4	2496.8	2505.2	0.0306	9.0741	9.1047	2
4	0.008 129	0.001 000 0	157.271	157.272	16.8	2492.1	2508.9	0.0611	8.9915	9.0526	4
6	0.009 345	0.001 000 0	137.779	137.780	25.2	2487.4	2512.6	0.0913	8.9102	9.0015	6
8	0.010 720	0.001 000 1	120.965	120.966	33.6	2482.6	2516.2	0.1213	8.8300	8.9513	8
10	0.012 270	0.001 000 3	106.429	106.430	42.0	2477.9	2519.9	0.1510	8.7510	8.9020	10
12	0.014 014	0.001 000 4	93.834	93.835	50.4	2473.2	2523.6	0.1805	8.6731	8.8536	12
14	0.015 973	0.001 000 7	82.899	82.900	58.8	2468.5	2527.2	0.2098	8.5963	8.8060	14
15	0.017 139	0.001 000 8	77.977	77.978	62.9	2466.1	2529.1	0.2243	8.5582	8.7826	15
16	0.018 168	0.001 001 0	73.383	73.384	67.1	2463.8	2530.9	0.2388	8.5205	8.7593	16
18	0.020 624	0.001 001 3	65.086	65.087	75.5	2459.0	2534.5	0.2677	8.4458	8.7135	18
20	0.023 366	0.001 001 7	57.837	57.838	83.9	2454.3	2538.2	0.2963	8.3721	8.6684	20
25	0.031 660	0.001 002 9	43.401	43.402	104.8	2442.5	2547.3	0.3670	8.1922	8.5592	25
30	0.042 415	0.001 004 3	32.928	32.929	125.7	2430.7	2556.4	0.4365	8.0181	8.4546	30
35	0.056 216	0.001 006 0	25.244	25.245	146.6	2418.8	2565.4	0.5049	7.8495	8.3543	35
40	0.073 750	0.001 007 8	19.545	19.546	167.5	2406.9	2574.4	0.5721	7.6861	8.2583	40
45	0.095 820	0.001 009 9	15.275	15.276	188.4	2394.9	2583.3	0.6383	7.5277	8.1661	45
50	0.123 35	0.001 012 0	12.045	12.046	209.3	2382.9	2592.2	0.7035	7.3741	8.0776	50
55	0.157 41	0.001 014 5	9.577 9	9.578 9	230.2	2370.8	2601.0	0.7677	7.2248	7.9925	55
60	0.199 20	0.001 017 1	7.677 5	7.678 5	251.1	2358.6	2609.7	0.8310	7.0798	7.9108	60
65	0.250 09	0.001 019 9	6.201 3	6.202 3	272.0	2346.3	2618.4	0.8933	6.9388	7.8321	65
70	0.311 62	0.001 022 8	5.045 3	5.046 3	293.0	2334.0	2626.9	0.9548	6.8017	7.7565	70
75	0.385 49	0.001 025 9	4.133 1	4.134 1	313.9	2321.5	2635.4	1.0154	6.6681	7.6835	75
80	0.473 60	0.001 029 2	3.408 1	3.409 1	344.9	2308.8	2643.8	1.0753	6.5380	7.6133	80
85	0.578 03	0.001 032 6	2.827 8	2.828 8	355.9	2296.1	2652.0	1.1343	6.4111	7.5454	85
90	0.701 09	0.001 036 1	2.360 3	2.361 3	376.9	2283.2	2660.1	1.1925	6.2873	7.4798	90
95	0.845 26	0.001 039 9	1.981 2	1.982 2	398.0	2270.2	2668.1	1.2501	6.1665	7.4166	95
100	1.013 25	0.001 043 7	1.672 0	1.673 0	419.1	2256.9	2676.0	1.3069	6.0485	7.3554	100
105	1.208 0	0.001 047 7	1.418 3	1.419 3	440.2	2243.6	2683.7	1.3630	5.9331	7.2962	105
110	1.432 7	0.001 051 9	1.208 9	1.209 9	461.3	2230.0	2691.3	1.4185	5.8203	7.2388	110
115	1.690 6	0.001 056 2	1.035 3	1.036 3	482.5	2216.2	2698.7	1.4733	5.7099	7.1832	115
120	1.985 4	0.001 060 6	0.890 46	0.891 52	503.7	2202.2	2706.0	1.5276	5.6017	7.1293	120
125	2.321 0	0.001 065 2	0.769 17	0.770 23	525.0	2188.0	2713.0	1.5813	5.4957	7.0769	125
130	2.701 3	0.001 070 0	0.667 07	0.668 14	546.3	2173.6	2719.9	1.6344	5.3917	7.0261	130
135	3.130 8	0.001 075 0	0.580 74	0.581 81	567.7	2158.9	2726.6	1.6869	5.2897	6.9766	135
140	3.613 8	0.001 080 1	0.507 41	0.508 49	589.1	2144.0	2733.1	1.7390	5.1894	6.9284	140
145	4.155 2	0.001 085 3	0.444 89	0.445 97	610.6	2128.7	2739.3	1.7906	5.0910	6.8815	145
150	4.760 0	0.001 090 8	0.391 36	0.392 45	632.1	2113.2	2745.4	1.8416	4.9941	6.8358	150
155	5.433 3	0.001 096 4	0.345 55	0.346 44	653.8	2097.4	2751.2	1.8923	4.8989	6.7911	155
160	6.180 6	0.001 102 2	0.305 66	0.306 76	675.5	2081.3	2756.7	1.9425	4.8050	6.7473	160
165	7.007 7	0.001 108 2	0.271 29	0.272 40	697.3	2064.8	2762.0	1.9923	4.7126	6.7048	165
170	7.920 2	0.001 114 5	0.241 44	0.242 55	719.1	2047.9	2767.1	2.0416	4.6214	6.6630	170
175	8.924 4	0.001 120 9	0.215 42	0.216 54	741.1	2030.7	2771.8	2.0906	4.5314	6.6221	175
180	10.027	0.001 127 5	0.192 67	0.193 80	763.1	2013.2	2776.3	2.1393	4.4426	6.5819	180
185	11.233	0.001 134 4	0.172 63	0.173 86	785.3	1995.2	2780.4	2.1876	4.3548	6.5424	185
190	12.551	0.001 141 5	0.155 18	0.156 32	807.5	1976.7	2784.3	2.2356	4.2680	6.5036	190
195	13.987	0.001 148 9	0.139 69	0.140 84	829.9	1957.9	2787.8	2.2833	4.1821	6.4654	195
200	15.549	0.001 156 5	0.126 01	0.127 16	852.4	1938.6	2790.9	2.3307	4.0971	6.4278	200
205	17.243	0.001 164 4	0.113 87	0.115 03	875.0	1918.8	2793.8	2.3778	4.0128	6.3906	205
210	19.077	0.001 172 6	0.103 07	0.104 24	897.7	1898.5	2796.2	2.4247	3.9293	6.3539	210
215	21.060	0.001 181 1	0.093 45	0.094 625	920.6	1877.6	2798.3	2.4713	3.8463	6.3176	215
220	23.198	0.001 190 0	0.084 85	0.086 038	943.7	1856.2	2799.9	2.5178	3.7639	6.2817	220
225	25.501	0.001 199 2	0.071 15	0.078 349	966.9	1834.3	2801.2	2.5641	3.6820	6.2461	225
230	27.976	0.001 208 7	0.070 24	0.071 450	990.3	1811.7	2802.0	2.6102	3.6006	6.2107	230
235	30.632	0.001 218 7	0.064 03	0.064 245	1013.8	1788.5	2802.3	2.6561	3.5194	6.1756	235
240	33.478	0.001 229 1	0.058 42	0.059 645	1037.6	1764.6	2802.2	2.7020	3.4386	6.1406	240
245	36.523	0.001 239 9	0.051 37	0.054 606	1061.6	1740.0	2801.6	2.7478	3.3579	6.1057	245
250	39.776	0.001 251 3	0.048 79	0.050 037	1085.8	1714.7	2800.4	2.7935	3.2773	6.0708	250
255	43.246	0.001 263 2	0.048 79	0.045 896	1110.2	1688.5	2798.7	2.8392	3.1968	6.0359	255
260	46.943	0.001 275 6	0.040 86	0.042 130	1134.9	1661.5	2796.4	2.8848	3.1161	6.0010	260
265	50.877	0.001 288 7	0.037 43	0.038 710	1159.9	1633.5	2793.5	2.9306	3.0353	5.9658	265
270	55.058	0.001 302 5	0.034 29	0.035 588	1185.2	1604.6	2789.9	2.9763	2.9541	5.9304	270
275	59.496	0.001 317 0	0.031 42	0.032 736	1210.9	1574.7	2785.5	3.0222	2.8725	5.8947	275
280	64.202	0.001 332 4	0.028 80	0.030 126	1236.8	1543.6	2780.4	3.0683	2.7903	5.8586	280
285	69.186	0.001 348 7	0.026 38	0.027 733	1263.2	1511.3	2774.5	3.1146	2.7074	5.8220	285
290	74.461	0.001 365 9	0.024 17	0.025 535	1290.0	1477.6	2767.6	3.1611	2.6237	5.7848	290
295	80.037	0.001 384 4	0.022 13	0.023 513	1317.3	1442.6	2759.8	3.2079	2.5389	5.7469	295
300	85.927	0.001 404 1	0.020 25	0.021 649	1345.1	1406.0	2751.0	3.2552	2.4529	5.7081	300
305	92.144	0.001 425 2	0.018 41	0.019 927	1373.4	1367.7	2741.1	3.3029	2.3656	5.6685	305
310	98.700	0.001 443 0	0.016 88	0.018 334	1402.4	1327.6	2730.0	3.3512	2.2766	5.6278	310
315	105.61	0.001 472 6	0.015 09	0.016 856	1432.1	1285.5	2717.6	3.4002	2.1856	5.5858	315
320	112.89	0.001 499 5	0.013 98	0.015 480	1462.6	1241.1	2703.7	3.4500	2.0923	5.5423	320
325	120.56	0.001 528 9	0.012 67	0.014 195	1494.0	1194.0	2688.0	3.5008	1.9961	5.4969	325
330	128.63	0.001 561 5	0.011 43	0.012 989	1526.5	1143.6	2670.2	3.5528	1.8962	5.4490	330
335	137.12	0.001 597 8	0.010 26	0.011 854	1560.3	1089.5	2649.7	3.6063	1.7916	5.3979	335
340	146.05	0.001 638 7	0.009 14	0.010 780	1595.5	1030.7	2626.2	3.6616	1.6811	5.3427	340
345	155.45	0.001 685 8	0.008 07	0.009 763	1632.5	966.4	2598.9	3.7193	1.5636	5.2828	345
350	165.35	0.001 741 1	0.007 06	0.008 799	1671.9	895.7	2567.7	3.7800	1.4376	5.2177	350
355	175.77	0.001 808 5	0.006 05	0.007 859	1716.6	813.8	2530.4	3.8489	1.2953	5.1442	355
360	186.75	0.001 895 9	0.005 04	0.006 939	1764.2	721.3	2485.4	3.9210	1.1390	5.060	360
365	198.33	0.002 016 0	0.003 99	0.006 011	1818.0	610.0	2428.0	4.0021	0.9558	4.9579	365
370	210.54	0.002 213 6	0.002 76	0.004 972	1890.2	452.6	2342.8	4.1108	0.7036	4.8144	370
374	220.81	0.002 842 7	0.000 63	0.003 465	2046.7	109.5	2156.2	4.3493	0.1692	4.5185	374
374.15	221.20	0.003 17	0	0.003 17	2107.4	0	2107.4	4.4429	0	4.4429	374.15

Tab.2 – Proprietà termodinamiche dell'acqua – Vapore surriscaldato

Pressione bar (temp. sat. °C)		50	100	150	200	250	300	350	400	500	600	700	300
	v	74.524	86.080	97.628	109.171	120.711	132.251	143.790	155.329	178.405	201.482	224.558	247.634
0.02	h	2594.4	2688.5	2783.7	2880.0	2977.7	3076.8	3177.7	3279.7	3489.2	3705.6	3928.8	4158.7
(17.5)	s	8.9226	9.1934	9.4327	9.6479	9.8441	10.0251	10.1934	10.3512	10.6413	10.9044	11.1464	11.3712
	v	37.240	43.027	48.806	54.580	60.351	66.122	71.892	77.662	89.201	100.740	112.278	123.816
0.04	h	2593.9	2688.3	2783.5	2879.9	2977.6	3076.8	3177.4	3279.7	3489.2	3705.6	3928.8	4158.7
(29.0)	s	8.6016	8.8730	9.1125	9.3279	9.5241	9.7051	9.8735	10.0313	10.3214	10.5845	10.8265	11.0513
	v	24.812	28.676	32.532	37.383	40.232	44.079	47.927	51.773	59.467	67.159	74.852	82.544
0.06	h	2593.5	2688.0	2783.4	2879.8	2977.6	3076.7	3177.4	3279.6	3489.2	3705.6	3928.8	4158.7
(36.2)	s	8.4135	8.6854	8.9251	9.1406	9.3369	9.5179	9.6863	9.8441	10.1342	10.3973	10.6394	10.8642
	v	18.598	21.501	24.395	27.284	30.172	33.058	35.944	38.829	44.599	50.369	56.138	61.908
0.08	h	2593.1	2687.8	2783.2	2879.7	2977.5	3076.7	3177.3	3279.6	3489.1	3705.5	3928.8	4158.7
(41.5)	s	8.2797	8.5521	8.7921	9.0077	9.2041	9.3851	9.5535	9.7113	10.0014	10.2646	10.5066	10.7314
	v	14.869	17.195	19.512	21.825	24.136	26.445	28.754	31.062	35.679	40.295	44.910	49.526
0.10	h	2592.7	2687.5	2783.1	2879.6	2977.4	3076.6	3177.3	3279.6	3489.1	3705.5	3928.8	4158.7
(45.8)	s	8.1757	8.4486	8.6888	8.9045	9.1010	9.2820	9.4504	9.6083	9.8984	10.1616	10.4036	10.6284
	v	0.001012	3.4181	3.8893	4.3560	4.8205	5.2839	5.7467	6.2091	7.1335	8.0574	8.9810	9.9044
0.50	h	209.29	2682.6	2780.1	2877.7	2976.1	3075.7	3176.6	3279.0	3488.7	3705.2	3928.6	4158.5
((81.3)	s	0.70349	7.6953	7.9406	8.1587	8.3564	8.5380	8.7068	8.8649	9.1552	9.4185	9.6606	9.8855
	v	0.001012	1.6955	1.9363	2.1723	2.4061	2.6387	2.8708	3.1025	3.5653	4.0277	4.4898	4.9517
1.00	h	209.33	2676.2	2776.1	2875.4	2974.5	3074.5	3175.6	3278.2	3488.1	3704.8	3928.2	4158.3
(99.6)	s	0.70347	7.3618	7.6137	7.8349	8.0342	8.2166	8.3858	8.5442	8.8348	9.0982	9.3405	9.5654
	v	0.001012	0.001044	0.959 54	1.0804	1.1989	1.3162	1.4328	1.5492	1.7812	2.0129	2.2442	2.4754
2.00	h	209.42	419.14	2768.5	2870.5	2971.2	3072.1	3173.8	3276.7	3487.0	3704.0	3927.6	4157.8
(120.2)	s	0.70342	1.30679	7.2794	7.5072	7.7096	7.8937	8.0638	8.2226	8.5139	8.7776	9.0201	9.2452
	v	0.001012	0.001044	0.633 74	0.716 35	0.796 44	0.875 29	0.953 52	1.0314	1.1865	1.3412	1.4957	1.6499
3.00	h	209.5	419.21	2760.4	2865.5	2967.9	3069.7	3171.9	3275.2	3486.0	3703.2	3927.0	4157.3
(133.5)	s	0.70338	1.30671	7.0771	7.3119	7.5176	7.7034	7.8744	8.0338	8.3257	8.5898	8.8325	9.0577
	v	0.001012	0.001044	0.470 66	0.534 26	0.595 19	0.654 85	0.713 85	0.772 50	0.889 19	1.0054	1.1214	1.2372
4.00	h	209.59	419.29	2752.0	2860.4	2964.5	3067.2	3170.0	3273.6	3484.9	3702.3	3926.4	4156.9
(143.6)	s	0.70333	1.30664	6.9285	7.1708	7.3800	7.5675	7.7395	7.8994	8.1919	8.4563	8.6992	8.9246
	v	0.001012	0.001044	0.001091	0.424 96	0.47443	0.522 58	0.570 05	0.617 16	0.710 78	0.803 95	0.896 85	0.989 56
5.00	h	209.68	419.36	632.16	2855.1	2961.1	3064.8	3168.1	3272.1	3483.8	3701.5	3925.8	4156.4
(151.8)	s	0.70328	1.30656	1.84161	7.0592	7.2721	7.4614	7.6343	7.7948	8.0879	8.3626	8.5957	8.8213
	v	0.001012	0.001043	0.001091	0.352 04	0.393 91	0.434 39	0.474 19	0.513 61	0.591 84	0.669 63	0.747 14	0.824 47
6.00	h	209.76	419.44	632.23	2849.7	2951.6	3062.3	3166.2	3270.6	3482.7	3700.7	3925.1	4155.9
(158.8)	s	0.70324	1.30648	1.8415	6.9662	7.1829	7.3740	7.5479	7.7090	8.0027	8.2678	8.5111	8.7368
	v	0.001012	0.001043	0.001091	0.299 92	0.336 37	0.371 39	0.405 71	0.439 64	0.506 89	0.573 68	0.640 21	0.706 55
7.00	h	209.85	419.51	632.29	2844.2	2954.0	3059.8	3164.3	3269.0	3481.6	3699.9	3924.5	4155.5
(165.0)	s	0.70319	1.3064	1.84139	6.8859	7.1066	7.2997	7.4745	7.6332	7.9305	8.1959	8.4395	8.6653
	v	0.001012	0.001043	0.001091	0.260 79	0.293 21	0.324 14	0.354 34	0.384 16	0.443 17	0.501 72	0.560 01	0.618 11
8.00	h	209.93	419.59	632.35	2838.6	2950.4	3057.3	3162.4	3267.5	3480.5	3699.1	3923.9	4155.0
(170.4)	s	0.70314	1.30632	1.84128	6.8148	7.0397	7.2348	7.4107	7.5729	7.8678	8.1336	8.3773	8.6033
	v	0.001012	0.001043	0.001091	0.230 32	0.259 63	0.278 39	0.314 40	0.341 01	0.393 61	0.445 76	0.497 63	0.549 33
9.00	h	210.02	419.66	632.41	2832.7	2946.8	3054.7	3160.5	3266.0	3479.4	3698.2	3923.3	4154.5
(175.4)	s	0.7031	1.30624	1.84116	6.7508	6.9800	7.1771	7.3540	7.5169	7.8124	8.0785	8.3225	8.5486
	v	0.001012	0.001043	0.00109	0.205 92	0.232 75	0.257 98	0.282 43	0.306 49	0.353 96	0.400 98	0.447 73	0.494 30
10.00	h	210.11	419.74	632.47	2826.8	2943.0	3052.1	3158.5	3264.4	3478.3	3697.4	3922.7	4154.1
(179.9)	s	0.70305	1.30616	1.84105	6.6922	6.9259	7.1251	7.3031	7.4665	7.7627	8.0292	8.2734	8.4997
	v	0.001011	0.001043	0.001090	0.132 38	0.151 99	0.169 70	0.186 53	0.202 92	0.235 03	0.266 66	0.298 03	0.329 21
15.00	h	210.54	420.11	632.78	2794.7	2923.5	3038.9	3148.7	3256.6	3472.8	3693.3	3919.6	4151.7
(198.3)	s	0.70282	1.30577	1.8405	6.4508	6.7099	6.9207	7.1044	7.2709	7.5703	7.8385	8.0838	8.3108
	v	0.001011	0.001043	0.001090	0.001156	0.111 45	0.125 50	0.138 66	0.151 13	0.175 55	0.199 50	0.223 17	0.246 66
20.00	h	210.97	420.49	633.09	852.55	2902.4	3025.0	3138.6	3248.7	3467.3	3689.2	3916.5	4149.4
(212.4)	s	0.70258	1.30538	1.83994	2.32995	6.5454	6.7696	6.9596	7.1296	7.4323	7.7022	7.9485	8.1763
	v	0.001011	0.001043	0.001089	0.001156	0.086 985	0.098 925	0.109 75	0.120 04	0.139 87	0.159 21	0.178 26	0.197 14
25.00	h	211.4	420.86	633.4	852.76	2879.5	3010.4	3128.2	3240.7	3461.7	3685.1	3913.4	4147.0
(223.9)	s	0.70235	1.30499	1.83939	2.32916	6.4077	6.6470	6.8442	7.0178	7.3240	7.5956	7.8431	8.0716
	v	0.001011	0.001042	0.001089	0.001155	0.070 551	0.081 159	0.090 526	0.099 310	0.116 08	0.132 34	0.148 32	0.164 12
30.00	h	211.83	421.24	633.71	852.96	2854.8	2995.1	3117.5	3232.5	3456.5	3681.0	3910.3	4144.7
(233.8)	s	0.70212	1.3046	1.83883	2.32838	6.2857	6.5422	6.7471	6.9246	7.2345	7.5079	7.7564	7.9857
	v	0.001011	0.001042	0.001089	0.001155	0.058 693	0.068 424	0.076 776	0.084 494	0.099 088	0.113 15	0.126 94	0.140 54
35.00	h	212.26	421.62	634.03	853.17	2828.1	2979.0	3106.5	3224.2	3450.6	3676.9	3907.2	4142.4
(242.5)	s	0.70188	1.30421	1.83828	2.32759	6.1732	6.4491	6.6626	6.8443	7.1580	7.4332	7.6828	7.9128
	v	0.00101	0.001042	0.001088	0.001154	0.001251	0.058 833	0.066 446	0.073 376	0.086 341	0.098 763	0.110 90	0.122 85
40.00	h	212.69	421.99	634.34	853.37	1085.78	2962.0	3095.1	3215.7	3445.0	3672.8	3904.1	4140.0
(250.3)	s	0.70165	1.30382	1.83773	2.32681	2.79343	6.3642	6.5870	6.7733	7.0909	7.3680	7.6187	7.8495
	v	0.00101	0.001041	0.001088	0.001154	0.00125	0.051 336	0.058 696	0.064 721	0.076 427	0.087 570	0.098 425	0.109 10
45.00	h	213.12	422.37	634.65	853.58	1085.77	2944.2	3083.3	3207.1	3439.3	3668.6	3901.0	4137.7
(257.4)	s	0.70142	1.30343	1.83718	2.32603	2.79221	6.2852	6.5182	6.7093	7.0311	7.3100	7.5619	7.7934

Pressione bar (temp. Sat.°C)		50	100	150	200	250	300	350	400	500	600	700	800
	v	0.00101	0.001041	0.001088	0.001153	0.001249	0.045 301	0.051 941	0.057 791	0.068 494	0.078 616	0.088 446	0.098 093
50.00	h	213.55	422.74	634.96	853.79	1085.76	29255	3071.2	3198.3	3433.7	3664.5	3897.9	4135.3
(263.9)	s	0.70119	1.30304	1.83663	2.32525	2.791	6.2105	6.4545	6.6508	6.9770	7.2578	7.5108	7.7431
	v	0.001009	0.001041	0.001087	0.001152	0.001248	0.036 145	0.042 222	0.047 379	0.056 592	0.065 184	0.073 478	0.081 587
60.00	h	214.41	423.49	635.58	854.21	1085.75	2885.0	3045.8	3180.1	3422.2	3656.2	3891.7	4130.7
(275.6)	s	0.70072	1.30227	1.83554	2.3237	2.78859	6.0692	6.3386	6.5462	6.8818	7.1664	7.4217	7.6550
	v	0.001009	0.00104	0.001086	0.001151	0.001246	0.029 457	0.035 233	0.039 922	0.048 086	0.055 590	0.062 787	0.069 798
70.00	h	215.26	424.25	636.21	854.63	1085.75	2839.4	3018.7	3161.2	3410.6	3647.9	3885.4	4126.0
(285.8)	s	0.70026	1.30149	1.83445	2.32217	2.78621	5.9327	6.2333	6.4536	6.7993	7.0880	7.3456	7.5808
	v	0.001009	0.00104	0.001086	0.00115	0.001244	0.024 264	0.029 948	0.034 310	0.041 704	0.048 394	0.054 770	0.060 956
80.00	h	216.12	425	636.84	855.06	1085.77	2786.8	2989.9	3141.6	3398.8	3639.5	3879.2	4121.5
(295.0)	s	0.69979	1.30072	1.83337	2.32064	2.78386	5.7942	6.1349	6.3694	6.7262	7.0191	7.2790	7.5158
	v	0.001008	0.001039	0.001085	0.001149	0.001245	0.001402	0.025 792	0.029 29	0.036 737	0.042 798	0.048 534	0.054 080
90.00	h	216.98	425.75	637.47	855.49	1085.79	1344.55	2959.0	3121.2	3386.8	3631.1	3873.0	4116.7
(303.3)	s	0.69933	1.29995	1.83229	2.31912	2.78153	3.25329	6.0408	6.2915	6.6600	6.9574	7.2196	7.4579
	v	0.001008	0.001039	0.001084	0.001148	0.001241	0.001398	0.022 421	0.026 408	0.032 760	0.038 320	0.043 546	0.048 580
100.00	h	217.84	426.5	638.1	855.92	1085.83	1343.36	2925.8	3099.9	3374.6	3622.7	3866.8	4112.0
(311.0)	s	0.69887	1.29919	1.83121	2.31761	2.77923	3.24878	5.9489	6.2182	6.5994	6.9013	7.1660	7.4058
	v	0.001007	0.001037	0.001083	0.001146	0.001236	0.001388	0.016 122	0.020 010	0.025 590	0.030 259	0.034 510	0.038 682
125.00	h	219.99	428.39	639.67	857.02	1085.96	1340.65	2828.0	3042.9	3343.3	3601.4	3851.1	4100.3
(327.8)	s	0.69771	1.29728	1.82854	2.31387	2.77357	3.23797	5.7155	6.0481	6.4654	6.7796	7.0504	7.2942
	v	0.001006	0.001036	0.001081	0.001143	0.001232	0.001378	0.011 462	0.015 661	0.020 795	0.024 884	0.028 587	0.032 086
150.00	h	222.13	430.27	641.26	858.14	1086.16	1338.25	2694.8	2979.1	3310.6	3579.8	3835.4	4088.6
(342.1)	s	0.69656	1.29638	1.8259	2.31018	2.76804	3.22776	5.4467	5.8876	6.3487	6.6764	6.9536	7.2013
	v	0.001005	0.001036	0.00108	0.001141	0.001229	0.001369	0.001716	0.012 460	0.017 359	0.021 043	0.024 314	0.027 376
175.00	h	224.27	432.16	642.85	859.27	1096.41	1336.14	1663.62	2906.3	3276.5	3557.8	3819.7	4077.0
(354.6)	s	0.69541	1.29351	1.82328	2.30655	2.76265	3.21808	3.764	5.7274	6.2432	6.5858	6.8698	7.1215
	v	0.001003	0.001034	0.001078	0.001139	0.001225	0.001361	0.001666	0.009 947 0	0.014 771	0.018 161	0.021 111	0.023 845
200.00	h	226.41	434.05	644.45	860.43	1086.72	1334.26	1647.18	2820.5	3241.1	3535.5	3803.8	4065.3
(365.7)	s	0.69427	1.29614	1.82068	2.30296	2.75737	3.20885	3.73084	5.5585	6.1456	6.5043	6.7953	7.0511
	v	0.000999	0.001029	0.001072	0.00113	0.001211	0.001322	0.001554	0.002 830 6	0.008 680 8	0.011 436	0.013 647	0.015 619
300.00	h	234.95	441.62	650.9	865.2	1088.42	1328.69	1610.04	2161.8	3085.0	3443.0	3739.7	4018.5
	s	0.68971	1.2843	1.81053	2.28907	2.73735	3.17565	3.64552	4.4896	5.7972	6.2340	6.5560	6.8288
	v	0.000995	0.001024	0.001066	0.001122	0.001198	0.001308	0.00149	0.001 909 1	0.005 615 6	0.008 088 4	0.009 930 2	0.011 521
400.00	h	243.46	449.22	657.44	870.2	1090.76	1325.39	1589.69	1934.1	2906.8	3346.4	3674.8	3971.7
	s	0.68519	1.27714	1.80072	2.27584	2.71879	3.14688	3.58848	4.1190	5.4762	6.0135	6.3701	6.6606
	v	0.000991	0.00102	0.001061	0.001114	0.001187	0.001287	0.001444	0.001 729 1	0.003 882 2	0.006 111 3	0.007 719 7	0.009 075 9
500.00	h	251.94	456.83	664.06	865.4	1093.61	1323.69	1576.39	1877.7	2723.0	3248.3	3610.2	3925.3
	s	0.68069	1.27014	1.79123	2.26319	2.70145	3.12127	3.54361	4.0083	5.1782	5.8207	6.2138	6.5222
	v	0.000988	0.001016	0.001055	0.001107	0.001176	0.00127	0.001408	0.001 632 4	0.002 915 5	0.004 835 0	0.006 269 0	0.007 460 3
600.00	h	260.39	464.46	670.74	880.76	1096.88	1323.17	1567.15	1847.3	2570.6	3151.6	3547.0	3879.6
	s	0.67622	1.26331	1.78203	2.25105	2.68513	3.09806	3.5059	3.9383	4.9374	5.6477	6.0775	6.4031
	v	0.000984	0.001012	0.00105	0.001101	0.001166	0.001254	0.001379	0.001 567 1	0.002 466 8	0.003 971 9	0.005 256 6	0.006 320 8
700.00	h	268.81	472.1	677.48	886.27	1100.51	1323.57	1560.58	1827.8	2467.1	3060.4	3486.3	3835.3
	s	0.67177	1.25662	1.76308	2.23937	2.66967	3.07674	3.473	3.8855	4.7688	5.4931	5.9562	6.2979
	v	0.000980	0.001008	0.001045	0.001094	0.001157	0.00124	0.001355	0.001 518 0	0.002 188 1	0.003 379 2	0.004 519 3	0.005480 5
800.00	h	277.2	479.75	684.28	891.92	1104.43	1324.7	1555.92	1814.2	2397.4	2980.3	3428.7	3792.8
	s	0.66733	1.25006	1.76438	2.22811	2.65497	3.05696	3.4436	3.8425	4.6488	5.3595	5.8470	6.2034
	v	0.000977	0.001004	0.001041	0.001088	0.001149	0.001227	0.001334	0.001 478 8	0.002 012 9	0.002 966 8	0.003 964 2	0.004 840 7
900.00	h	285.55	487.4	691.12	897.87	1108.62	1326.43	1552.7	1804.6	2349.9	2913.5	3374.6	3752.4
	s	0.6629	1.24363	1.75591	2.21721	2.64093	3.03845	3.41686	3.8059	4.5602	5.2468	5.7479	6.1179
	v	0.000973	0.001	0.001036	0.001082	0.001141	0.001216	0.001315	0.001 446 4	0.001 893 4	0.002 668 1	0.003 535 6	0.004 341 1
1000.00	h	293.87	495.07	698	903.53	1113.02	1328.65	1550.6	1797.6	2316.1	2857.5	3324.4	3714.3
	s	0.65848	1.23732	1.74764	2.20666	2.62748	3.02102	3.39225	3.7738	4.4913	5.1505	5.6579	6.0397